Site 162 Mill Pond

Overview: The Mill Pond potential restoration site is located upstream of the Route 127 (Washington Street) crossing over Mill River in the City of Gloucester. Mill River follows in a northerly direction into the Annisquam River before reaching Ipswich Bay. The coastal embankment is also crossed further upstream by Dr. Osman Babson Road which provides access to the Middle School. The area is city-owned and is an active WRP restoration project under development and sponsored by City of Gloucester officials. Phase I of the project consisted of leaving the existing sluice gate at the Route 127 crossing in an open potions beginning in April 2004 to restore partial tidal flow to approximately 24 ac. The current nonstandard assessment focused on the collection of tide data and an inspection of the existing crossing structures.

A series of 3 tide gauges were deployed between April 21 and May 16, 2005. One gauge was deployed in Mill River, downstream of the control structure at the bridge on Route 127 (Washington Street) which separates Mill River from Mill Pond to the south. Mill River is open to Ipswich Bay to the north. Two tide gauges were deployed in Mill Pond upstream and downstream of twin culverts at the Dr. Osman Babson Road crossing. Mill Pond is fed by Mill River to the north through the control structure at Washington Street. Results of the tide gauge deployments showed that there is a significant restriction of tidal flow from Mill River to Mill Pond due to the control structure. Restrictions occurred during each of the 48 tidal cycles recorded and the restriction becomes more severe as the tide height increases. The degree of restriction ranges from 0.99-1.83 ft and delays range from 1 hr 13 min to 1 hr 53 min. The highest tide during the deployment period occurred on May 7 at 11:36 PM. The 1988 NAVD adjusted height of the water in Mill River was 7.11 ft. The adjusted water height in Mill Pond was 5.28 ft. at 1:29 AM on May 8. The control structure at the Washington Street bridge caused a tidal dampening from Mill River to Mill Pond of 1.83 ft and a delay of 1 hour and 53 minutes. The dampening amounted to 26.4% of the total tidal prism in Mill River.

There was no significant restriction in Mill Pond due to the twin culverts at Dr. Osman Babson Rd. Restrictions ranged between 0.8 and 0.17 ft and delays were all les than 10 min. except for May 9 and 11 during the morning tide when the recorded delay was 15 min. This period of the highest recorded tides coincided with a significant storm event and precipitation in excess of one inch. During this period, water was impounded at higher than normal conditions in Mill Pond. This effect was less noticeable above the Dr. Osman Babson Road crossing. The damping of the tides within Mill Pond during this period provided important flood control to several low lying properties along Washington Street and Poplar Street near the City Department of Pubic Works entrance. A restriction of approximately 1.2 ft occurs during more typical spring tide events. Measured salinities recorded on a near slack, ebbing tide were 18.3 ppt in Mill River, 5.8 ppt downstream of the twin culverts in Mill Pond, and 1.3 ppt upstream of the culverts. These values are indicative of significant freshwater contributions to the marsh system, especially during spring conditions. There is a relatively large watershed contributing fresh water to Mill Pond including the Babson Reservoir.

In addition to the severe tidal restriction and extensive filling of historical tidelands, there are several other impairments observed within the Mill Pond wetland system, including extensive stands of *Phragmites*, obstructed ditches, impounded conditions north of Dr. Osman Babson Road, accumulation of fine sediment, and periodic discharges from the upstream water treatment sludge lagoons. It is likely that the severe restriction in tidal flows has also resulted in subsidence of the salt marsh plain upstream of the bridge crossing. However, the lack of extensive salt marsh development in close proximity to either side of the bridge crossing did not allow for an accurate comparison.

Structure Conditions: The Route 127 Bridge is a concrete deck on concrete abutments, with a span of approximately 15 ft. Water is conveyed under the bridge via a 14.5 ft wide by 11.5 ft high CMP Plate Arch culvert. In 1969, a concrete flow control structure was reconstructed between the upstream wing walls of the bridge. The previous flow structure was built in 1938, however its configuration is unknown. There were reportedly two larger culverts along Washington Street during the 1920's. There were no available records at the City Engineering Department indicating the age of the current Route 127 Bridge itself. Flow is currently regulated by a sluice gate with a 5 ft-wide by 3 ft-high opening. The sluice gate is operational but is currently maintained in an open position. The flow structure also includes a 5.5 ft- wide by 3.5 ft-high notch or spillway adjacent to the tide gate opening. The spillway base elevation is 2.6 ft NAVD and has notched sides to accommodate flash boards. No boards were in place at the time of inspection.

MassHighway records identify the bridge as G-05-03. Both MassHighway and the City Department of Public Works are unaware of any past structural inspections. Bridge structures with spans greater than 20 ft are routinely (every two years) inspected by MassHighway. The Bridge is approximately 48 ft wide and supports two travel lanes, shoulders, and two concrete side walks. There are a number of below ground utilities which pass through the structure including gas and water, but no sewer. There are also a large number of overhead utilities on the upstream side of the crossing.

The Route 127 Bridge is in fair condition based on those portions of the structure which could be visually inspected. Concrete on the bridge deck and abutments is spalling (spalling is when the concrete breaks away from the structure and is usually caused by rebar in the concrete corroding). Also the guardrail is deteriorating and the connections to the bridge have weakened due to corrosion and spalling of the concrete. The concrete associated with the flow control structure is in good condition.

The roadway and embankment are in good condition. The embankment is protected from erosion and scour by placed cut stone slope paving. Based on these conditions, the life expectancy of the Route 127 Bridge is estimated to be 10-15 years.

The next upstream crossing of the tidal system occurs at Dr. Osman Babson Road. This road accesses the adjacent Middle School and is under the control of the School District. Water is conveyed under Dr. Osman Babson Road via twin 60 in CMP Plate culverts. The ends of the pipes have been beveled so as to follow the embankment slope. The upstream and downstream inverts have riprap scour protection. An excessive amount of riprap placed at the upstream end of the culverts results in a slight impounding condition. The embankment is also protected from erosion and scour by large placed riprap. Both pipes and the adjacent upstream and downstream embankments are in good condition.

Construction Logistics/Feasibility: Increased tidal flushing at this site would require modifications to the existing flow control structure connected to the upstream wing walls of the bridge. The complete removal of the flow control structure would likely result in flooding impacts to several low lying properties along Washington Street and Poplar Street near the City Department of Pubic Works entrance. The lowest elevation of lawns associated with these properties is approximately 5.4 ft NAVD. The lowest inhabited building elevations are approximately 7.0 ft. There are several out buildings associated with these properties which lie between these elevations. Currently, city officials are not aware of any existing flooding issues at these locations. However, there have been reports of flooding to properties along Poplar Street

upstream of the DPW facility which abut the stream flowing from the Babson Reservoir. It would appear these problems are more related to the hydraulic capacity of the stream and series of culverts within this reach rather than water levels in Mill Pond. However, any possible relationship should be investigated further.

There is little question that the existing Route 127 bridge provides important flood control during severe coastal storm events. The elevation of the roadway is approximately 8.3 ft NAVD or approximately 0.4 ft below the predicted 100-year tidal event predicted by the US Army Corps of Engineers. The top of the flow control structure set slightly below the predicted one-year tidal flood elevation.

As the flow control structure functions independent from the bridge, there is an opportunity to modify the existing openings and not affect the structural integrity of the existing bridge. This approach is relatively inexpensive and may provide interim benefits until the entire bridge structure is reconstructed, probably some time in the next 10 to 15 years. There are currently no plans for the reconstruction of the bridge. Hydraulic modeling will be required to determine the benefits provided by increasing the existing openings while maintaining the flood protection during larger coastal storms. The existing configuration of the sluice gate and notch with flashboard installation capabilities affords the opportunity to manipulate water levels within Mill Pond. The sluice gate has been left open since 2004 as the initial phase in the restoration of Mill Pond. The ability to manage water levels needs to be reviewed by the City as this factor influences potential restoration options. However, it is likely that any proposed increases in tidal exchange will require provisions to regulate the flow to gain local support.

Enlarging of existing openings within the concrete wall of the flow control structure would be a relatively straight forward construction operation and would likely only require a limited shoulder closure. Dewatering needs would be minimal as the work could be scheduled around favorable tide conditions. The extensive overhead utilities would not be impacted. The work would likely be done with wet saws. The use of pneumatic hammers would not be recommended because of potential impacts to the adjacent abutments. A protective coating such as epoxy would then have to be applied to the exposed concrete to prevent corrosion. The size of the opening would be dependant on the structural stability of the existing concrete wall, impacts to upstream water levels, and ability to control (or shut down) the additional openings. A structural review of the flow control structure design plans suggests the existing weir can be cut to, or slightly below, the elevation invert of the sluice gate. This modification would more than double the expositing hydraulic opening during a mean spring tide event. A channel bracket designed to support flash boards could be fastened to the sides of the weir. This modification would avoid the costs associated with installation of a second gate. Construction costs associated with this concept are estimated to be $70,000.

The site would be difficult for the installation of SRTs due to the low invert of the existing opening. The turbulence associated with the downstream side of the water control structure may also influence the performance of an STR mounted on this side of the wall. SRTs could be retrofitted to the downstream end of the culverts under Dr. Osman Babson Road. However, this would only control flooding upstream of this point. Automated sluice gates installed at Washington Street would enhance flood protection but would substantially increase costs associated with this interim solution. Complete removal of the flow control structure (although structurally possible), or replacement of the entire bridge structure, were not considered practical alternatives at this time.

Future steps toward implementing further restoration at Mill Pond should include: gathering bathymetric data to support hydraulic modeling, preliminary modeling of options available to enlarge openings within the existing structure, preliminary modeling of future bridge replacement options for planning purposes, coordination with the City to determine the necessary level of water management control, detailed bridge inspection to verify life expectancy, and further engineering to refine cost estimates. Further studies should also consider the feasibility of removing historic fill from former tide lands fringing the pond.

Site # 162 | Site Features | Scale: 1:4,000

Photo 1 - Upstream View at Route 127 Crossing

Photo 2 - Tide Gate

Photo 3 - Upstream View from Route 127 Crossing

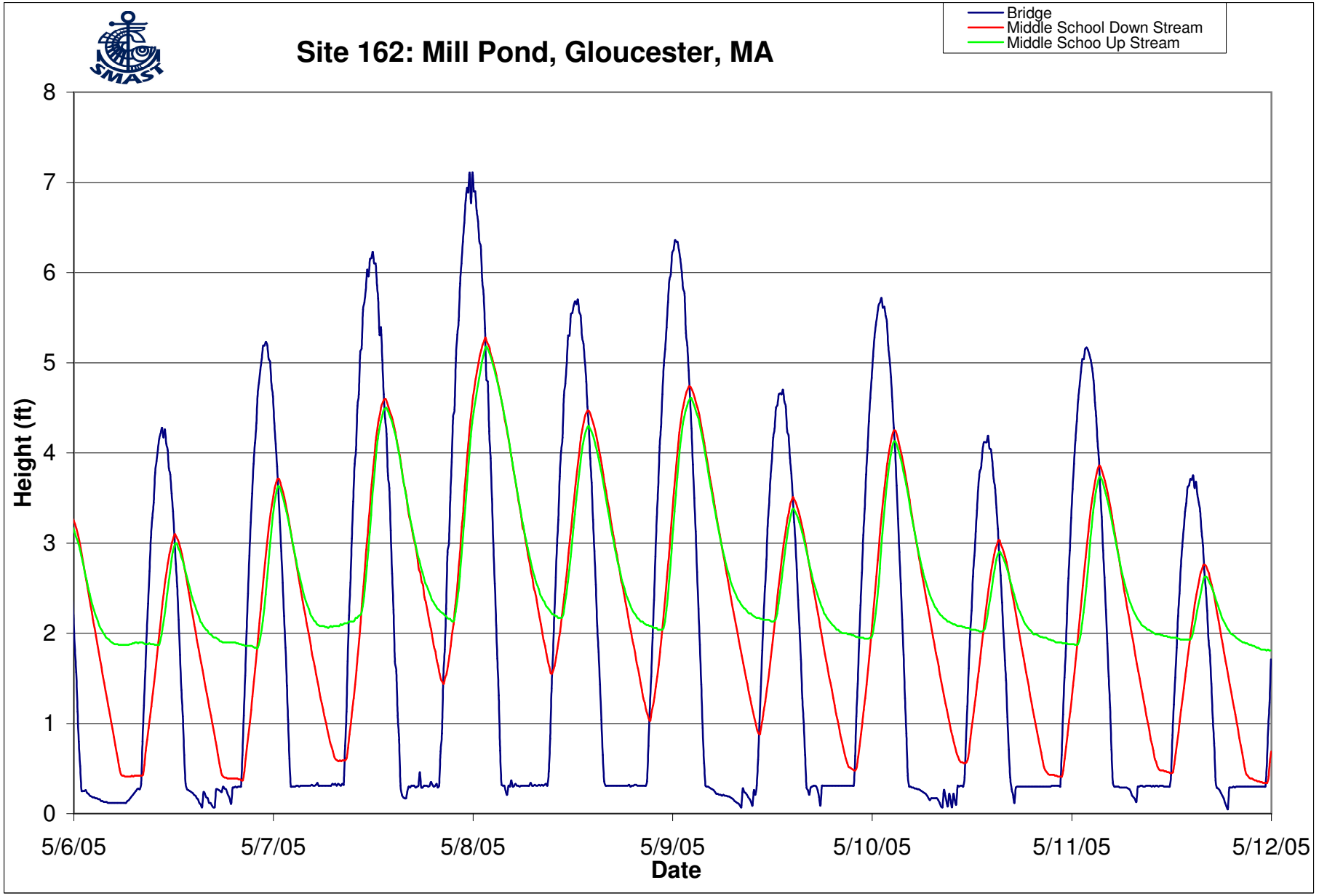
Photo 4 - Downstream View from Route 127 Crossing

Photo 5 - Downstream View from Babson Road Crossing

Photo 6 - Downstream View of Babson Road Crossing

Photo 7 - Upstream View from Babson Road Crossing

Photo 8 - Upstream of Babson Road Crossing


Site 162: Mill Pond, Gloucester, MA
Bridge
Middle School Down Stream
Middle Schoo Up Stream
Height (ft)
0
1
2
3
4
5
6
7
8
5/6/05
5/7/05
5/8/05
5/9/05
5/10/05
5/11/05
5/12/05
Date